It is more important he should know that the process is only commercially profitable because the ammonia is recovered, thus getting hold of the principle of the utilization of by-products, than that he should know the factory terms for the machinery and operations. A good course in manufacturing equipment, in which different types of furnaces, towers and the like were grouped and compared might be of great practical and educational importance. But isolated bits of such information have no such value.

Our high-school chemistry might well include a treatment of more organic compounds than it has in the past. This knowledge can readily be acquired by reference to inorganic types. So many of the simpler derivatives of the hydrocarbons are things of every-day life that in order to include them we can afford to sacrifice some of the things of the traditional elementary course. The pupil needs, moreover, some intimation of the character and extent of the organic branch of the science.

In conclusion, the speaker feels that the best hope for the improvement of high school chemistry lies in discussions of the kind we are engaged in this morning. The experimental end of our work has been so new and interesting that much of our time has been spent on these matters. But the time is at hand when a reconsideration of the course as a whole in its general relations would be of benefit to the teaching of the elementary science.

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CHEMISTRY IN SECONDARY SCHOOLS[1]

IT is not necessary in a gathering such as this to recount the stages in the history of chemistry teaching in secondary schools —how, from the purely descriptive natural philosophy of the early college we finally essayed the teaching of chemistry and physics as sciences; how the miscellaneous encyclopedic instruction has been replaced by courses, designed, in these latter days, to develop power for the pupil rather than to impart knowledge.

The changes in content and method of formal secondary-school instruction have been brought about by the colleges; by advice, by supplying the teachers and most drastically, by the requirements for admission. While the bulk of the class might pass from the school and not be heard from again, the failure of a pupil to pass the college examination is quickly brought home to the teacher, so that the entrance examinations have become the standard of the school.

During the last fifteen years four syllabuses have been published which have decidedly affected the teaching of chemistry in schools; in 1894 that of the Committee of Ten, descriptive and general; in 1898 a Harvard syllabus, largely quantitative and scientific in method; in 1900, the syllabus of the College Entrance Examination Board, a plan for a course I hesitate to classify; in 1905, the last revision of the syllabus of the New York Department of Education, a historico-systematic course.

There is almost nothing in common to these four courses, and although the College Entrance Examination Board maintains and strengthens its hold upon the schools it has never, fortunately for the pupils, conducted its chemistry examination in accordance with its syllabus.

If we examine the texts to find what is being taught in high schools we find the chemistry text-books to be descriptive or theoretical; very few have successfully

[1] Presented at the second decennial celebration of Clark University, Worcester, Mass., September 16, 1909.

combined the two. The descriptive texts usually become encyclopedic, try to include all the elements, strange compounds, the latest processes and weird discoveries, often curtailing or entirely displacing those common things we are too liable to take for granted that every one knows. The theoretic texts are largely the product of college men. These tend to become too abstract and sacrifice the pupil to the subject. One elementary text of very wide use devotes two pages to a discussion of the action of bleaching powder, but does not state how it is used or for what goods.

If a subject is to be treated as a science many facts must be given and understood in order that the pupil may acquire a comprehensive idea of the subject. It is folly to expect thorough understanding of a part without a general knowledge of the whole. The high schools can not train chemists or engineers. Time and cost do not admit of such intensive science teaching, even if it is desirable. Such teaching should be left to the college.

If we take the pupils as we find them in our large city high schools they are not well informed and have little opportunity to be. They live in a complex environment. The city boy or girl is brought in contact with but few simple phenomena; a push of a button—a bell is rung; another push—a door is unlocked; another push—a light appears. The modern apartment is a complicated structure operated by buttons. If we look for chemical actions within this pupil's sphere we find them to be rather few, too familiar to hold the attention or too complicated to tempt analysis. He comes in contact with but few elements and but few pure compounds. Steel is to him a specially pure iron, zinc is the metal used in batteries, tin—used for cans, sulphur smells bad. He has often been told that soda water contains no soda. Soap is useful in cleaning, as it eats dirt as an acid "eats metals." A material involving electric means is necessarily superior.

The tendency to centralization in driving out small industrial establishments has narrowed the child's opportunities for observation. The shops of the blacksmith, carpenter and soap-maker where he learned the art of critical observation and learned some things not taught in school, have been withdrawn behind doors marked "no admission."

The classes of our large schools are mixed as to sex, race and ability. It is often said with pride that our urban population is cosmopolitan, but that the second generation from the emigrant is acquainted with American ways. Admitting that the second generation may be somewhat acquainted with American ways, we must also admit that the population of our large cities is becoming mongrel. The mongrel is never stable and is rarely successful. The psychology of the mongrel is analogous to that of the mob. Is it not then asking too much that children one or two generations from barbarity should be put through the same course and be expected to meet the same educational standards as the natives of Massachusetts?

The tendency of education at present is the development of *power*, of ability to reason, to think. We may, indeed, ask if the drill along this line has not been pushed so far at times as to neglect giving something to think about. The school, unlike the college, works by the clock, the work must be cut to fit the time, thus we often find a few facts or questions are presented in such a way that but one conclusion is possible. This is called inductive teaching—teaching to reason.

It makes the work easier for the teacher

if the work can be made to follow a mathematical model, so problems come to take an important place. The work becomes quantitative and is now held to develop thought, originality and logical reasoning. But the problem in elementary chemistry is usually of type form, and is not the teacher largely sponging on the power drilled into the pupil by the mathematics teacher? The English of the schools is criticized by college and business men alike. I believe a clear, concise exposition of phenomena in correct language will be of more benefit to the pupil than any number of problems in chemical arithmetic.

The pupils I have in mind are the ordinary ones in large schools, thirteen to sixteen years of age, girls and boys. Only a small percentage will go to college, some will go to business, some to be clerks, some home makers, some teachers. They have been herded in elementary schools, taught *at* in bulk. They are deficient in English and any correct notions of the activities of the world. It is the business of the high school to supplement the elementary school and by its specialization correct the errors of the grades and systematize the instruction. College preparation is only incidental.

A large amount of knowledge is not needed in practical life so much as the power to do things, but knowledge certainly increases power. While we must be able to do one thing well even a superficial knowledge of many things is not to be despised. Good judgment, ability to arrive at accurate conclusions from given data is most essential, but if we look closely a large part of what is commonly called reasoning is but rehearsing of formulæ. Good judgment can not be taught. So few of our pupils will ever be so situated that they need reason independently concerning chemical phenomena that it is scarcely justifiable to foist the time and cost of such instruction on the public.

Where and how can chemistry accomplish the most good in the school? If the object of education is to develop a youth most completely, to make a well-rounded individual, to make him feel an intelligent interest in the activities of the world, it is not necessary that each factor in such a total should be well rounded. A number of smooth, well-rounded sticks will make a very insecure bundle, but if some of the sticks are somewhat rough the bundle may not appear so elegant but it will be more firm. Chemistry touches every phase of human activity. It requires language for its expression, mathematics for its determination, physics for its operation. Its history is the history of the world.

It would be impossible to find a better subject than chemistry to bind together the school work, to systematically furnish splinters to make the bundle strong. The domestic science teacher, the biology teacher and the physics teacher give some splinters of information which they call chemistry and build their work upon this basis, usually indigestible definitions. A systematic course in elementary science should be placed in the first year of the high school, designed to impart that information of things and processes we might well expect every one to know. This might be followed later by a course more thorough.

We now expect our pupils to specialize as soon as they leave the elementary schools and to prepare for some life work. He or she knows nothing of human activities out in the everyday world, there is practically no place in the school curriculum where this is taught. We have trade schools, vocation schools, commercial schools, not to mention others all of which require him to specialize before showing

him any general plan from which to choose or guiding his choice.

The pupil who will receive no further school instruction can in a year be given a good knowledge, by a teacher with adequate equipment, of many of the facts of elementary chemistry relating to our daily life and its activities—a knowledge sufficient in most cases to excite a lasting interest in natural phenomena and to cause the student to seek explanation. There is a multitude of chemical facts which concern the boy who goes into the shop or office or behind the counter, and which he should know. The girl who will stop at home or teaches others' children is also concerned with chemical phenomena. chemical information which has been crowded out of her curriculum to make room for more cultured and less mussy subjects.

Adhering to traditional procedure, our science courses have become pseudotheoretical or pseudotechnical; it is time we had one systematically informational and practical. Facts are as important as explanations and should precede them. Such a course need not pretend completeness in any line. It might be comparative rather than critical. It would not attempt to rediscover or verify natural laws, but would aim to cultivate the powers of observation and of accuracy of description, to express ideas of phenomena in simple, direct English rather than to hide incoherent thought behind a big name or a slang expression.

In a first course in chemistry, atoms, molecules, ions and many other terms might be omitted altogether. They are but words, the modern idea of an atom is incomprehensible to one without a wide knowledge of chemistry. Theory should be eliminated as much as possible, making the course treat of facts, their sequence and relation to one another. Numerical problem solving should take but a small part in recitation work. No more can come out of an equation than we put into it. It can not develop originality.

Such a course for children of twelve to thirteen years would need simplicity in its treatment. Faraday's lectures to children are a model in this respect. Ostwald's "Conversations" show how some complicated things may be dealt with simply.

I would have such a course give information concerning natural phenomena and the work of man, show what is being done, and how, without technical detail.

I would give the pupil something to *know*. Facts that are worth knowing in and of themselves—facts that concern himself, his food, his clothing, his shelter and his work. Concerning the things he or she will meet in life, no matter whether the future be as a chemist, a bookkeeper or in the kitchen. The material is ample.

The subject might be systematized by its applications rather than the traditional order. Study topics rather than elements; study detergents, not soap; study bleaching rather than peroxide or bleaching powder. The development of the race through the stone, bronze and iron age has depended largely upon his chemical knowledge. Let us study the metals in their metallic aspects rather than according to the periodic table.

Foods, clothing, materials of utility and convenience or of commerce often can not be rationally treated by the present systems of our texts, but a suitable systematization might easily include these; what they are, how they are produced and what they do.

In its effects upon the pupil and school, we may be sure that pupils who have seen something of the general trend of the instruction through a systematic preliminary

course will feel more interest to continue study and will accomplish more and better work in later courses.

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THE AMERICAN MEDICAL ASSOCIATION[1]

THE St. Louis session of the American Medical Association was an unqualified success. From the scientific point of view, and from the effect in the promotion of a closer and more harmonious organization of the profession, as well as of social interest, little more could have been desired. The registration was a little over four thousand, a number exceeded only twice—at Boston and at Chicago.

In the scientific interest and in the earnestness and fulness of the discussions on the topics presented the section meetings equaled or surpassed those of any previous session. Every section had profitable meetings and the attendance in each was good. Especially notable were the symposiums in the Section on Preventive Medicine and Public Health on hookworm, pellagra and typhoid fever, and in the Section on Pathology and Physiology on cancer—subjects which, aside from their interest to the profession, have particular interest for the public, because of the wide-spread morbidity and mortality which they cause, especially in the instances of typhoid fever and cancer. Indeed, it is interesting to note the many points at which the papers throughout the whole program of this session touched the public directly in the matter of hygiene, sanitation and prevention. It is a reflection of the wide-spread interest of the public in what is being done in medicine. In many respects the Section on Preventive Medicine was the most interesting of the session. Cancer, with its frightful mortality and increasing prevalence, was probably the most prominent subject of the session, being considered in one or more of its aspects in almost every section, far outshadowing tuberculosis in this respect. In some of the other sections symposiums on diabetes, the infectious diseases and eclampsia, with the discussions, served to clear the atmosphere about many mooted questions. There were many other interesting features of the scientific program, but space forbids further mention of them here.

[1] From the *Journal* of the Association.

The meetings of the house of delegates were harmonious throughout. Each succeeding year the reference committees are doing more and more work, making it possible to investigate thoroughly all the various propositions that come before the house; and thus the house is able to accomplish much more, and to do the work in a deliberate, satisfactory manner. Of the important things done by the house of delegates, one was the creation of a new Section on Genito-urinary Diseases, as petitioned for by many members doing work in that line. Another was the creation of the Council on Health and Public Instruction, which is to have charge of the work formerly done by several overlapping committees, covering such matters as preventive medicine, medical legislation, economics, public instruction in medical, sanitary and hygienic questions, etc. The council will organize complete machinery to facilitate the attainment of these objects.

Any impression that there was the slightest lack of harmony in the organization was dispelled by the work of the house of delegates and by the spirit shown in the daily work; and any attempted disparagement of the aims and purposes of the American Medical Association was silenced by the splendid statement of them contained in the address of President Welch at the general meeting. That the public correctly understands these aims and endorses them was evinced in the admirable address of Governor Hadley and the other gentlemen who spoke at the general meeting.

THE ASTRONOMICAL OBSERVATORY OF DENISON UNIVERSITY

AT Denison University, Granville, Ohio, the new astronomical observatory, presented by Mr. Ambrose Swasey, of Cleveland, was opened